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(19)

(54) A FLOW CONTROL DEVICE

(71) I, LENNART GUSTAF BERG, a Swedish subject of Fylgiavägen 1, S-182 64 Djursholm, Sweden, do hereby declare the invention, for which I pray that a patent may be granted to me and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a flow control device. Known flow control devices of the type envisaged having the form of shut-off or control valves are normally provided with fibre washers. Such washers become worn with use, whereupon leaks occur, or in the case of valves which are but seldomly opened, become fastened to the valve seating, rendering it difficult to open the valve when desiring to do so.

The object of the present invention is to provide a novel type of flow control device which at least substantially eliminates the aforementioned disadvantages encountered with known flow control devices of the type comprising two mutually axially movable members, one of which is mounted within the other, such as for example a cylinder having a plunger arranged therein.

According to the present invention there is provided a flow control device comprising two mutually axially movable members, one of which is mounted within the other, there being arranged at least one radial through-flow opening in the wall of one of said two movable members, while the other of said members is arranged while co-acting with a sealing element mounted between said two movable members to alternately expose and close said radial opening, and the sealing element comprising a ring-shaped, rigid support member having an elastic sleeve slidably arranged therearound, said support member, and therewith also the sleeve, having an elongate surface portion which faces the said one wall in which said radial through-flow opening is arranged and which extends in the direction of the mutual axial movement of said two members, and the sleeve being arranged to roll along at least the wall with the opening therein during said mutual axial movement between said two members.

In a preferred embodiment of the invention, the support means has elongate surface portions which face both of the mutually axially movable members.

The support means may comprise a smooth, relatively thin metal ring around which the elastic sleeve can readily roll when the inner and outer surfaces of the sleeve roll against respective sealing surfaces. The construction is such as to obviate the necessity of providing special guide means for the sealing element. However, to prevent wandering of the sealing element with repeated backward and forward relative movement between the sealing surfaces, the sleeve may be provided with a radially extending bead on its outside and/or inside, for retention of said sleeve at respective surfaces. Further, the beads may be so positioned that in one position of said mutual, axial movements of the two members the beads are located in one and the same radial plane.

The invention will now be described by way of example with reference to the accompanying drawings, in which Fig. 1 is an axial section through one embodiment of a sealing element incorporated in a device according to the invention, Fig. 2 is a sectional view through a second embodiment of a sealing element, Fig. 3 is a longitudinal sectional view through a valve according to the invention having a sealing element according to Fig. 2, with the valve closed, and Fig. 4 is a sectional view corresponding to Fig. 3 with the valve open.

The sealing element of Fig. 1 comprises

a support member 1 having the form of a ring-shaped, thin steel band of relatively large axial extension. The support member has smooth side surfaces and accurately rounded corners. Extending around the support member 1 is a sleeve 2 of elastic material, such as cast rubber, which is pretensioned to a certain extent. An appropriate lubricant may be applied between the sleeve 2 and the support member 1 to reduce friction therebetween and to facilitate movement of the sleeve 2 around member 1.

When this sealing element is to be used as a seal in a valve, between a plunger and a surrounding cylinder surface, it is convenient to provide in one of the sealing surfaces guide means in the form of a circular groove of substantially the same configuration as one half cross section of the sealing element cut along a circle having a radius generally equal to the mean radius of the sealing element. The sealing element is partially inserted radially into the groove, thereby preventing tendency of the sealing element to wander. If the groove is cut in the plunger, the outer surface of the sealing element will roll on the surrounding cylinder surface as the plunger is moved backwards and forwards while the inner surface of said element must slide in the circular groove and hence said groove should preferably be cut in a material having a lower coefficient of friction than the said cylinder surface.

The sealing element of Fig. 2 is substantially of the same design as that shown in Fig. 1, having a circular support member 1 of strip steel and a surrounding sleeve 2. With the embodiment of Fig. 2, however, the sleeve 2 has two beads 3 and 4 which, in one position, are arranged to bear against respectively the inner and outer surface of the support member 1 in the same radial plane. The beads 3 and 4 are intended to be clamped securely in a groove or the like arranged in an inner and an outer sealing surface, respectively, thereby obviating the need of providing guide means for entraining the sealing element with the mutual movement of the sealing surfaces.

In Figs. 3 and 4 there is shown a shut off valve constructed in accordance with the invention and having a sealing element according to Fig. 2. The valve is intended for use with different media, such as liquids and gasses for example, and comprises an outer housing 5, suitably of cylindrical configuration, having an inlet stub 6, which extends concentrically with the housing 5, and an outlet stub 7, which extends perpendicularly to the housing 5 at a position axially removed from the stub 6. The outer housing 5 has a central, axial bore 8, which is connected at one end to the inlet stub 6 and at the other is covered by a cap 9 which is inserted in the bore 8 and secured thereto by screws 10 and which is sealed against the walls of the bore by means of an O-ring 11. Arranged in the bore 8 is a cup-shaped inner housing 12, the outer diameter of which is smaller than the diameter of bore 8 and on the outside of the closed end of which there is provided a number of distance means 13 which bear against a shoulder 14 extending around the end of stub 6 facing inwardly toward the outer housing 5. The length of the cup-shaped inner housing 12 is such that its open end bears against the inner surface of the cap 9, and a radially inwardly extending, ring-shaped flange 15 on the wall of bore 8 forms a guide means for the outer surface of the inner housing 12. As will be seen from the drawing, the guide flange 15 is provided with a circular groove, which is arranged to accommodate an O-ring 16, thereby sealing the cylindrical chambers on either side of the flange 15 in bore 8, around the inner housing 12, one from the other.

The inner housing 12 suitably comprises two parts 17 and 18. The joint between said parts is formed so as to build a circular groove on the inside thereof, in which the bead 4 on the sealing element 1, 2 can be firmly held. Further, the inner housing 12 is provided with a number of radially extending, through-passing holes 19 to the left of flange 15 as seen in Fig. 3, and with one or more radial openings 20 to the right of said flange. The openings 19 are arranged to communicate with the connecting stub 6 through the circular passage located between the bore 8 and the inner housing 12, while the openings 20 are arranged to connect the interior of said housing 12 with the connecting stub 7 through a radially widened portion in the bore 8.

Arranged for axial movement in the inner housing 12 is a plunger 21 having a stem 22 which extends through a bearing in cap 9 and which at its outer end is pivotally connected to a lever arm 23 pivotally mounted to the outer housing 5. The hole through which the plunger stem 22 passes in the cap 9 is sealed by means of an O-ring 24. Mounted on the stem 22 is a stop ring 25 which, by engagement with the cap 9, limits movement of the plunger 21 in a position where the plunger holds the connection through the valve closed.

The diameter of the plunger 21 is much smaller than the inner diameter of the inner housing 12, thereby providing room for the insertion of a sealing element 1, 2 in the cylindrical space between the plunger 21 and the inner wall of the inner

housing 12. Extending peripherally around the plunger 21 is a shallow groove arranged to accommodate the bead 3. Alternatively the plunger may be in two parts provided with radial division surfaces between which the groove is arranged. One end of the stem 22 is secured to the plunger 21 by appropriate means, and arranged in said end is an axially extending blind bore 26 which extends to within the confines of the plunger 21 and which is provided at its bottom portion with one or more radially extending openings 27, to provide a connection between the spaces on either side of the plunger 21 in the inner housing 12.

The dimensions of the support member, the thickness of the sealing element and the inner diameter of the inner housing 12 are so selected that the elastic sleeve 2 of said sealing element is compressed to some extent, whereby the sleeve effectively seals against the wall of the inner housing. When the plunger 21 is moved axially by actuating the lever 23, the sleeve 2 rolls against both the cylindrical surface of said plunger and the inner surface of the inner housing 12, thereby substantially preventing wear whilst at the same time the movement of said plunger is effected without any appreciable friction. Since the bead 3, and possibly also the bead 4, fixes the position of the sealing element relative the plunger and the inner housing, the sealing element is unable to wander with repeated reciprocating movement of the plunger. Neither is it necessary to provide means for guiding the sealing element, which facilitates the manufacture of the valve.

In the position shown in Fig. 3 the valve is closed, i.e. the sealing element 1, 2 covers the holes 19 in the wall of the inner housing 12, thereby blocking communication between the connecting stubs 6 and 7. When the lever 23 is moved down, as seen in Fig. 4, the plunger 21 is moved to the left and the sealing element 1, 2 rolls against the plunger surface and the support member 1 is caused to accompany the movement of said element, so that the sleeve also rolls against the wall of the inner housing 12, thereby exposing the holes 19 so that the working medium can flow through the valve. The medium can also flow through the openings 27 and the central bore 26 in the stem 22 to the rear side of the plunger, so that the pressure acting on either side thereof is balanced and the plunger remains in its valve-open position without requiring the provision of special latching means, it being possible to set the valve to all positions between the fully off and fully open positions and to retain said valve in said intermediate positions.

Since the sleeve 2 does not slide against respective sealing surfaces and is not pressed against said surfaces by any appreciable force, the sleeve is not subjected to wear and cannot fasten in any of the positions to which the valve is set, thereby enabling the valve to be operated with relative ease.

The illustrated valve only represents one embodiment of the invention. Since a valve constructed in accordance with the invention can be operated rapidly and the openings sealed by the sealing element quickly exposed, the invention is suitable for use with control valves and safety valves for example, although other fields of use are also conceivable.

WHAT I CLAIM IS:—

1. A flow control device comprising two mutually axially movable members, one of which is mounted within the other, there being arranged at least one radial through-flow opening in the wall of said one of said two movable members, while the other of said members is arranged while co-acting with a sealing element mounted between said two movable members to alternately expose and close said radial opening, and the sealing element comprising a ring-shaped, rigid support member having an elastic sleeve slidably arranged therearound, said support member, and therewith also the sleeve, having an elongate surface portion which faces the said one wall in which said radial through-flow opening is arranged and which extends in the direction of the mutual axial movement of said two members, and the sleeve being arranged to roll along at least the wall with the opening therein during said mutual axial movement between said two members.

2. A device according to claim 1, characterized in that the support member has elongate surface portions which face both of said two mutually axially movable members.

3. A device according to claim 1 or 2, characterized in that the support member comprises a smooth, relatively thin metal ring.

4. A device according to any of the preceding claims, characterized in that the sleeve has an outwardly projecting bead which is arranged to be attached to one of said two mutually axially movable members.

2. A device according to claim 1, characterized in that the support member has elongate surface portions which face both of said two mutually axially movable members.

3. A device according to claim 1 or 2, characterized in that the support member comprises a smooth, relatively thin metal

ring.

4. A device according to any of the preceding claims, characterized in that the sleeve has an outwardly projecting bead which is arranged to be attached to one of said two mutually axially movable members.

5. A device according to any one of claims 1-3, characterized in that the sleeve has two outwardly projecting beads which are arranged to be attached to their respective ones of said two mutually axially movable members.

6. A device according to claim 5, characterized in that the beads are arranged so that in one position of axial movement of said two movable members said beads lie in one and the same plane.

7. A flow control device substantially as hereinbefore described with reference to the accompanying drawing.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

FIG.1

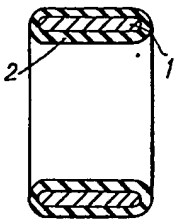


FIG.2

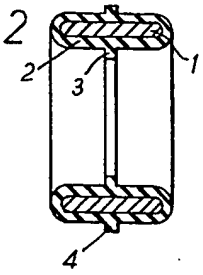


FIG.3

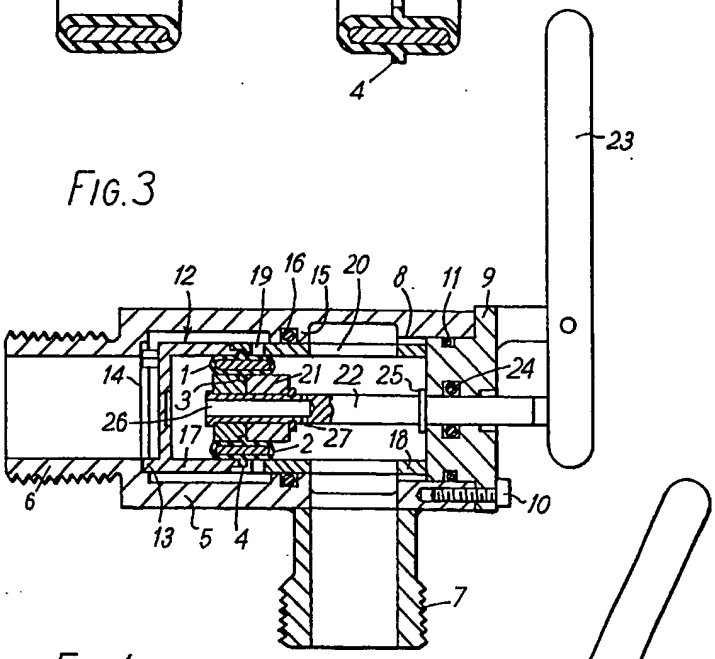
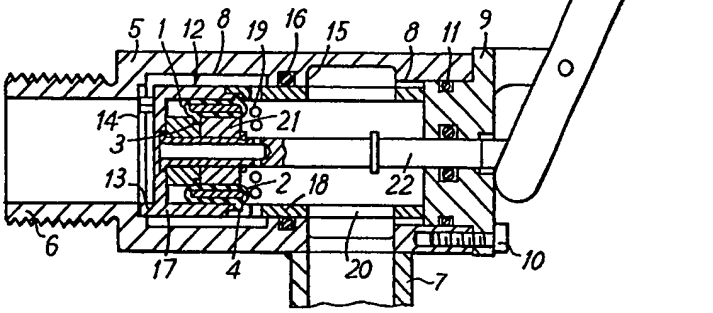


FIG.4



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